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SASKATCHEWAN PULSE TESTING NETWORK FOR EVALUATION OF BREEDING LINES AND NEW VARIETIES

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FINAL REPORT
TO
SASKATCHEWAN AGRICULTURE DEVELOPMENT FUND

For the research project
#20010314
Saskatchewan Pulse Testing Network for Evaluation of Breeding Lines and New Varieties

Submitted by
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(a) Abstract/Summary

Multi-location evaluation in target areas of adaptation of advanced breeding lines and new varieties is a critical component of plant breeding. The objectives of this project were to enhance the testing network for evaluation of breeding lines in the Crop Development Centre (CDC) pulse crop genetic improvement program, to conduct regional trials of dry bean and chickpea in Saskatchewan, and to provide field-based extension sites for pulse crops in Saskatchewan. Field pea, lentil, chickpea, and dry bean variety trials were successfully conducted in Swift Current, Assiniboia, Scott, Melfort, Oxbow, and Canora. This project facilitated the rapid development of improved pulse crop varieties and new pulse crop market classes for Saskatchewan growers; it provided up to date data describing the performance of new pulse crop varieties for Saskatchewan, and it provided excellent settings for pulse crop extension events.

(b) Executive Summary

This was a one year grant intended to fill an urgent need for pulse variety testing in Saskatchewan. The activities outlined in this proposal were supported in 2000 and 2001 by the Saskatchewan Pulse Growers and by AFIF.

Objectives:
1. To enhance the testing network for evaluation of breeding lines in the Crop Development Centre (CDC) pulse crop genetic improvement program.
2. To conduct regional trials of dry bean and chickpea.
3. To provide field-based extension sites for pulse crops in Saskatchewan.

Methodology:
Pulse crop (field pea, lentil, chickpea, and dry bean) breeding trials were conducted in their target areas of adaptation in Saskatchewan. Trials were set up and managed by the pulse crop breeding program at the CDC. Trials were planted, maintained and harvested by researchers located in the target areas, by the CDC Regional Variety Trial (RVT) crew based out of Saskatoon, or by the CDC pulse crop breeding program staff. The pulse crop breeding program at the CDC conducted post-harvest processing, data analysis, and reporting.

Results:
1. This research facilitated the rapid development of improved pulse crop varieties and new pulse crop market classes for Saskatchewan growers.
2. This research provided up to date data describing the performance of new pulse crop varieties for Saskatchewan.
3. This research provided excellent settings for pulse crop extension events.

(c) Technical Report

Background and rationale

In recent years, the pulse crop breeders at the CDC have had the opportunity to evaluate pulse crop breeding programs in Australia, Europe, India and the United States. In

comparison to the other regions, and especially in the context of the sheer size and scope of the Canadian pulse industry, the network of multilocation trial sites in Saskatchewan is sub-standard. In addition, the capacity for exchanging advanced trials with other breeding programs is extremely limited for pulse crops in comparison to cereals and oilseeds. The lentil and chickpea programs are unique, and other pea and bean breeding programs are poorly represented in Saskatchewan.

A critical component of a successful plant breeding program is an effective and reliable testing network for evaluation of new lines. This network must consist of:
1. A sufficient number of sites in the key target area for the crop(s) of interest. The sites must be representative of the current or potential production regions for the crop.
2. Capacity to evaluate sufficient numbers of lines from a diverse set of crosses to make good decisions on which to advance to co-operative or regional trials, and subsequently to release to growers.
3. A technical crew with expertise and experience to successfully grow and manage trials so that reliable data are produced from the maximum number of trial sites.
4. A flexible, responsive network that allows for timely collection of data to allow for appropriate decision making, for example, regarding which lines to increase over winter. This is of particular importance for pulse crops because the seed multiplication ratio is low in comparison to cereals in oilseeds.

The current testing network in the CDC pulse breeding program is insufficient to adequately meet the needs of an expanding industry. The current network consists of a limited set of testing sites within a 150 km radius of Saskatoon. Field pea lines are evaluated in Rosthern, Outlook, and Elrose; lentil lines in Rosthern and Elrose; chickpea lines in Elrose and Kyle; and dry bean lines in Rosthern and Outlook. These sites are managed from Saskatoon by the CDC pulse breeding crew using funds supplied primarily by the Saskatchewan Pulse Growers. The current network of sites was established in 1975, and at that time was representative of the pulse crop growing areas in the province. Now these crops have expanded to all areas of Saskatchewan and the testing network needs to be modernized.

An additional problem faced in the spring of 2002 was the fact that the AFIF support of dry bean and chickpea regional variety testing had ended. Without this grant, regional testing of these crops would not have occurred in 2002. Lack of a variety testing system would impair the genetic improvement and crop development effort for these important new pulse crops. In fact, under the current publication guidelines established by the Saskatchewan Advisory Council on Grain Crops, it would not have been possible to include new varieties of bean and chickpea in the Varieties of Grain Crops publication.

In 2000 and 2001, this proposal was financially supported by the Saskatchewan Pulse Growers without matching funds. In each season, trials at Melfort, Swift Current, and Scott were managed by senior technicians at the respective Agriculture and Agri-Food Canada (AAFC) stations. Trials at Assiniboia, Canora, and Carlyle were managed by the RVT crew. Useful data were collected at each site, allowing for timely decisions on which lines to advance to future trials and/or winter nursery increases.

Project Objectives

The objectives of this research project were:

1. To enhance the testing network for evaluation of breeding lines in the Crop Development Centre (CDC) pulse crop genetic improvement program.
2. To conduct regional trials of dry bean and chickpea.
3. To provide field-based extension sites for pulse crops in Saskatchewan.

Materials and Methods

Research plan

Pulse crop (field pea, lentil, chickpea, and dry bean) breeding trials were conducted in their target areas of adaptation in Saskatchewan (Table 1). For each site marked 'X', two advanced, elite, co-op, or regional trials were grown; trials generally consisted of 36 entries and two replications (i.e., 144 plots per 'X'). At Oxbow, additional bean trials were grown. The increased emphasis on this site is due to the recent expansion of dry bean production in the southeastern part of the province and the need for efficient selection in this promising new bean region. Trials were set up and managed by the pulse crop breeding program at the CDC. Trials were planted, maintained and harvested by researchers located in the target areas or by the CDC Regional Variety Trial (RVT) crew. In the case of dry bean trials at Oxbow, the CDC pulse breeding crew planted and harvested the bean nursery, with plot maintenance managed by a local grower, Wayne Amos. The pulse crop breeding program at the CDC conducted post-harvest processing, data analysis, and reporting. For the most part, the same sites and cooperators were utilized as were were successfully utilized in 2000 and 2001. Each trial included approximately four check varieties and 32 F_5-F_8 generation experimental lines or varieties. Harvested samples were transported to Saskatoon for weighing, data analysis, and reporting. Data were used to make timely decisions regarding advancement of lines to future trials.

A web-camera system was installed at the Oxbow site and was monitored on a regular basis. This technology allowed this distant sites to be monitored by the pulse breeding crew in Saskatoon, and allowing for timely decisions on herbicide and fungicide applications and harvest staging.

Table 1. Pulse network testing sites in 2002.

Area*	Site	Pea	Lentil	Chickpea	Dry bean	Co-operators
1	Swift Current	X	X	X		Yantai Gan and Cal McDonald (A/
1	Assiniboia		X	X		Steve Piche (RVT)
2	Scott	X	X	X		Stewart Brandt and Steve Dueck (A
3	Canora				X	Scott Anderson (A-A)
4	Oxbow				XXX	CDC Pulse crew and Wayne An
4	Melfort	X			X	Cecil Vera (AAFC)

*Refers to crop production areas as described by Saskatchewan Agriculture and Food

AAFC=Agriculture and Agri-Food Canada Research Centre; A-A=Agri-Arm site
RVT=Regional Variety Trial crew

Results and Discussion

Field Pea

Yield of the 36 entries in the CDC field pea Elite trial are summarized in Table 1. This trial was grown at nine sites in 2002; three of these sites (Swift Current, Scott, and Melfort) were supported by this grant. Yield at Swift Current was good and the coefficient of variation (CV) was low. At Scott the yield was low and the CV was moderate. At Melfort the yield was low and CV high, thus, this site was not included in the overall mean for the trial. Table 1 shows that many of the test lines (% mean in bold font) had greater yield than the relevant check(s). High yielders with good quality have been advanced to the Field Pea Co-op Test in 2003.

Yield of the 36 entries in the CDC field pea Advanced trial-01 are summarized in Table 2. This trial was grown at six sites in 2002; the Swift Current site was supported by this grant. Yield at Swift Current was good and the CV was low. Table 2 shows that many of the test lines (% mean in bold font) had greater yield than the checks. High yielders with good quality have been advanced to the Field Pea Co-op Test or the CDC Elite trial in 2003.

Yield of the 36 entries in the CDC field pea Advanced trial-02 are summarized in Table 3. This trial was grown at five sites in 2002; the Scott site was supported by this grant. Yield at Scott was low and the CV was moderate. Table 3 shows that many of the test lines (% mean in bold font) had greater yield than the checks. High yielders with good quality have been advanced to the CDC Elite trial in 2003.

Yield of the 36 entries in the CDC field pea Advanced trial-03 are summarized in Table 4. This trial was grown at five sites in 2002; the Melfort site was supported by this grant. Yield at Melfort was low and the CV was high, thus the Melfort site was not included in the overall mean for the trial. Table 4 shows that many of the test lines (% mean in bold font) had greater yield than the checks. High yielders with good quality have been advanced to the Field Pea Co-op Test or the CDC Elite trial in 2003.

In addition to field pea Advanced trials 01-03, four more advanced trials consisting of 36 entries each were grown at four-five locations each in 2002; these trials did not include sites that were part of this project.

Chickpea

Yield of the 12 entries in the 2002 kabuli chickpea Regional trial are summarized in Table 5. This trial was grown at ten sites in 2002, however, five of these were lost because of high CV and/or low yield due to drought (Scott – part of this project), severe ascochyta (Assiniboia – part of this project), deer damage (Cadillac), late maturity

(Outlook), and weeds (Bow Island). Yield at Swift Current was good and the CV was low. Although the yield data from Assinibioa was not included in the overall mean, the site provided excellent scoring for ascochyta blight reaction. Table 5 shows that many of the test lines (% mean in bold font) had greater yield than the checks. CDC Frontier (95NN-29) was released to Select seed growers in 2003 on the basis of good yield, fair ascochyta blight reaction, medium maturity, and medium seed size.

Yield of the 12 entries in the 2002 desi chickpea Regional trial are summarized in Table 6. This trial was grown at ten sites in 2002, however, four of these were lost because of high CV and/or low yield due to drought (Scott – part of this project), severe ascochyta (Assiniboia – part of this project), deer damage (Cadillac), and weeds (Bow Island). Yield at Swift Current was good and the CV was low. Although the yield data from Assinibioa was not included in the overall mean, the site provided excellent scoring for ascochyta blight reaction. Table 6 shows that many of the test lines (% mean in bold font) had greater yield than the checks. CDC Cabri (92073-40) was released to Select seed growers in 2003 on the basis of good yield, fair ascochyta blight reaction, early maturity, and large seed size.

Yield of the 20 entries in the 2002 kabuli chickpea Elite trial are summarized in Table 7. This trial was grown at six sites in 2002, however, two of these were not included in the overall mean because of high CV and/or low yield due to drought (Scott – part of this project), or severe ascochyta (Assiniboia – part of this project. Yield at Swift Current was good and the CV was moderate. Although the yield data from Assinibioa was not included in the overall mean, the site provided excellent scoring for ascochyta blight reaction. Table 7 shows that many of the test lines (% mean in bold font) had greater yield than the checks. High yielders with good quality have been advanced to the kabuli chickpea Regional trial in 2003.

Yield of the 16 entries in the 2002 desi chickpea Elite trial are summarized in Table 8. This trial was grown at seven sites in 2002, however, the Scott site (part of this project) was not included in the overall mean because of high CV and low yield due to drought. Yield at Swift Current was good and the CV was low. Yield and CV at Assiniboia were moderate. The Assinibioa site also provided excellent scoring for ascochyta blight reaction. Table 8 shows that many of the test lines (% mean in bold font) had greater yield than the checks. High yielders with good quality have been advanced to the desi chickpea Regional trial in 2003.

Lentil

Tables 9 and10 report the results of Lentil Co-operative Trials A (small-seeded) and B (large-seeded) respectively. Most lines exceeded the yield of the checks in both trials. Most of the best performing lines will be advanced to a third or second year of testing. Many of the small red lines show greatly improved yield in comparison to the yellow checks but are particularly greatly improved over the current commercials standards Crimson, Blaze and Robin. The red cotyledon line 1254S-1 will progress to breeder seed production for release in the spring of 2004 on the basis of favourable recommendations

from red lentil importers in India and Turkey. In the B trial, several medium large green entries showed improved colour retention and earlier maturity that the checks.

Dry bean

Summaries of yield for Dry Bean Co-operative Trials are presented in Table 11-13. For most market classes, yield performance of breeding lines continues to improve relative to the commercial checks. Early maturity is always a concern for dry bean production in short-season areas like Saskatchewan, so final decisions on variety release are tempered with maturity considerations. Based on 2002 results, three CDC lines are under consideration for release throught SPG's Variety Release Program: 316-13 black; SC 11745-3 pinto and 610-23 bayo. Dryland growers in Saskatchewan continue to show interest in expanding the production base for pinto bean, especially based on favourable results with CDC Pintium over a wide range of environmental conditions. At least 3 companies will be contracting pinto bean production in 2003, for processing and export from Saskatchewan origins.

Extension

Several of the regional chickpea and dry bean trials were used in field days for growers and industry representatives. Tom Warkentin and Bert Vandenberg spoke at several of these events (see details below). Results of this research project were described at winter extention meetings at which Tom Warkentin and Bert Vandenberg spoke (see details below).

Reporting

Data collected in the chickpea and dry bean regional trials were summarized by Tom Warkentin and Bert Vandenberg, respectively, and reported to the Saskatchewan Advisory Council on Grain Crops. Data were published in Varieties of Grain Crops (Saskatchewan Agriculture Food and Rural Revitalization).

Conclusions:

The objectives of this project were met.

1. This project enhanced the testing network for evaluation of breeding lines in the CDC pulse crop genetic improvement program.
2. This project allowed for the successful conduct of the regional trials of dry bean and chickpea in Saskatchewan.
3. This project provided field-based extension sites for pulse crops in Saskatchewan.

Papers/Presentations:

Tom Warkentin and/or Bert Vandenberg spoke at the following extension events at which this research project was described.

2002 Summer field days
July 10 at Scott organized by SPG
July 11 at Outlook, organized by SCIDC
July 24 at Redvers Agri-Arm site
July 25 at Canora Agri-Arm site
July 26 at SPG Select Growers field day in Saskatoon
July 30 at Rosthern organized by Seager Wheeler Farm
August 1 at Assiniboia and Lisieux organized by SAFRR and Wheatland Conservation

2002-2003 Winter extension meetings organized by SPG/SAFRR
Jan 27 at Outlook
Jan 29 at Humboldt
Jan 30 at Nipawin
Jan 31 at Canora
Feb 3 at Leader
Feb 4 at Swift Current
Feb 5 at Assiniboia
Feb 6 at Yellow Grass
Feb 11 at Lashburn

Information of benefit to producers, processors, or governments:

Since this project facilitated applied plant breeding, the benefits to growers is quite direct. New pulse crop varieties developed at the CDC are rapidly released to seed growers who in turn make them available quickly to producers.

(d) **Personnel:**

The majority of the funding for this project flowed through the CDC to off-station co-operators. One half-time technician's salary was charged to this account to cover the cost of seed preparation, post harvest weighing, data analysis, quality analysis, and reporting.

(e) Equipment:

A web-cam was installed at Redvers, focused on plots in the bean regional trial. This was the first year of this sub-project. From a technical point of view, the project was successful, allowing day-to-day observation of crop growth. The images were featured on the Agri-Arm website as a tool for generating interest in development of the dry bean crop in Saskatchewan.

(f) Project Developed Materials:
New pulse crop varieties and advanced breeding lines have been described above.

(g) Project Photos:
Tom Warkentin and Bert Vandenberg took many photos during the summer at many of the trial sites utilized in this project. Specific photos can be made available on request.

(h) Acknowledgement:
The Saskatchewan Agricultural Development Fund has been acknowledged in all presentations where this research project was mentioned.

Table 1. Yield (g/plot) of field pea varieties grown at nine locations in the 2002 CDC elite trial

Entry	Variety	Class	Suth	S-VSA	Scott	Rost	Outl	Elro	Swift	Mord	MEAN	%	Melf
1	CDC Mozart	Y	557	862	351	774	2557	722	1976	2010	1226	108	296
2	Alfetta	Y	417	594	314	480	2145	451	1507	1644	944	83	165
3	Eclipse	Y	695	939	295	687	2715	764	1726	2083	1238	109	290
4	Nitouche	G	494	867	330	695	2138	598	1457	1702	1035	92	338
5	203PMR-16	M	538	1036	375	726	2411	812	1991	1796	1211	107	170
6	CDC0101	Y	519	1039	322	588	2914	645	1842	1934	1225	108	214
7	CDC0102	Y	479	942	393	768	3077	561	1809	2220	1281	**113**	239
8	CDC0103	Y	677	792	258	667	3122	638	1779	1816	1219	108	262
9	CDC0104	Y	631	833	364	582	2225	747	1901	1579	1108	98	308
10	CDC0105	Y	369	693	375	687	2707	582	1614	1894	1115	99	150
11	CDC0106	G	503	947	355	568	2144	724	1773	1680	1087	**96**	310
12	CDC0107	G	752	1021	370	762	2952	798	1737	1806	1275	**113**	414
13	CDC0108	Y	695	1122	335	829	2428	720	1948	1719	1225	108	323
14	CDC653-8	Y	618	869	357	614	2952	722	1920	2016	1259	**111**	347
15	CDC651-2	Y	587	952	383	828	3154	584	2177	1914	1322	**117**	213
16	CDC728s-7	Y	612	936	365	566	2947	723	2056	2119	1291	**114**	220
17	CDC715s-4	Y	787	905	340	850	3197	827	2232	2168	1413	**125**	190
18	CDC672-1	G	446	760	306	580	2408	748	1518	1698	1058	94	268
19	CDC647-1	G	619	926	374	667	3314	536	2076	1896	1301	**115**	228
20	617-20	M	610	835	355	667	2619	743	1721	1782	1166	103	255
21	638-9	Y	658	948	252	742	2969	691	2054	2042	1294	**114**	316
22	639-26	Y	686	1027	266	567	2423	676	1756	1922	1166	103	463
23	728s-8	Y	597	1053	300	640	3193	772	2143	2223	1365	**121**	258
24	630-7	Y	596	1011	399	712	2993	861	2317	1906	1349	**119**	290
25	715s-11	Y	647	954	347	808	2795	654	1899	2140	1280	**113**	289
26	722s+724s-1	Y	670	909	327	625	3284	754	1552	2085	1276	**113**	218
27	676-4	G	588	809	283	502	2573	712	1800	1590	1107	**98**	326
28	672-2	G	638	1098	332	645	2539	957	1914	1989	1264	**112**	296
29	672-3	G	542	959	272	768	2800	838	1479	1772	1179	**104**	397
30	672-4	G	653	1044	388	704	2920	948	2158	2003	1352	**120**	226
31	901s-8	G	377	848	338	593	2338	669	1661	1680	1063	**94**	475
32	680-4	G	576	1031	359	912	2948	644	1975	1978	1303	**115**	346
33	791-1	D	637	870	392	728	2644	568	1879	1957	1209	107	264
34	74-2	D	714	918	293	807	2327	652	2035	1805	1194	106	123
35	648-32	Y	619	961	447	801	2571	663	1765	1960	1223	108	248
36	801-5	Y	577	990	267	801	2785	711	1944	2174	1281	**113**	134
	MEAN		594	325	338	693	2728	706	1864	1908	1220	108	274
	CV		12.7	17.5	14.9	10.5	16.7	14.2	6.3	6.1			24.6

REPS	2	6	2	2	2	2	2	2	2

NOTES

Class: Y=yellow, G=green, M=maple, D=Dun

Locations: Suth=Sutherland, Saskatoon; S-VSA=Saskatchewan Pulse Growers land near Saskatoon; Rost=Rosthern; Outl=Outlook-irrigated; Elro=Elrose; Swift=Swift Current; Mord=Morden; Melf=Melfort

Table 2. Yield (g/plot) of field pea varieties grown at six locations in 2002 CDC advanced trial-01

ENTRY	Variety	Class	Suth	Rost	Outl	Swift	Elro	Mord	MEAN	%
1	CDC Mozart	Y	290	539	2772	1304	457	1444	1134	104
2	Alfetta	Y	364	395	2404	1504	360	1051	1013	93
3	Eclipse	Y	568	550	2298	1350	675	1659	1183	108
4	Carrera	Y	382	333	2232	1861	343	1071	1037	95
5	878M-21	Y	384	518	3022	1439	652	1624	1273	**117**
6	1007M-6	Y	541	494	3262	2028	642	1905	1479	**135**
7	997M-21	Y	310	410	2756	1929	402	1445	1209	**111**
8	997M-24	Y	399	514	2709	1798	620	1787	1304	**119**
9	996M-4	Y	465	501	2647	1820	468	1511	1235	**113**
10	996M-5	Y	315	394	2385	1664	483	1459	1117	102
11	996M-16	Y	304	425	2243	1253	455	1534	1036	95
12	996M-18	Y	618	554	3114	1998	505	1668	1409	**129**
13	1101M-10	Y	321	451	2498	1960	518	1493	1207	**111**
14	1101M-11	Y	290	416	2166	1483	520	1137	1002	92
15	1101M-13	Y	394	498	2983	1855	462	1614	1301	**119**
16	1101M-14	Y	559	598	3553	1594	558	1826	1448	**133**
17	1101M-16	Y	441	468	2120	1958	455	1280	1120	103
18	1101M-17	Y	216	370	2405	1962	559	1630	1190	**109**
19	995M-8	Y	415	473	2477	1589	449	1497	1150	105
20	1003M-2	Y	434	629	3144	1745	619	1567	1356	**124**
21	1003M-4	Y	601	618	3137	1706	553	1843	1410	**129**
22	1003M-16	Y	420	446	2999	1744	359	1228	1199	**110**
23	1003M-19	Y	453	619	2656	1913	545	1524	1285	**118**
24	1003M-28	Y	432	617	2829	1795	563	1783	1337	**122**
25	1003M-45	Y	650	634	3204	2370	591	1508	1493	**137**
26	1287S-2	Y	476	617	2974	1743	735	1720	1378	**126**
27	1287S-4	Y	426	681	3295	1867	607	1765	1440	**132**
28	1258S-8	Y	444	422	2394	1452	473	1439	1104	101
29	1081D-1	Y	696	593	2466	1481	573	1654	1244	**114**
30	1093M-3	Y	793	655	2922	1752	531	1818	1412	**129**
31	1093M-6	Y	451	559	3064	1647	778	1849	1391	**127**
32	1093M-9	Y	460	633	2658	2086	454	1573	1311	**120**
33	1093M-14	Y	444	520	2423	1675	583	1600	1207	**111**
34	1073D-4	Y	596	367	2547	1953	460	1449	1228	**113**
35	1073D-12	Y	443	608	2257	1750	735	1622	1236	**113**
36	1287S-11	Y	505	512	3084	2014	635	1690	1407	**129**
	MEAN		452.75	517.512	2724.94	1751.11	538.25	1563	1258	115
	CV		19	17	11	12	19	6		
	REPS		2	2	2	2	2	2		

NOTES

Class: Y=yellow, G=green, M=maple, D=Dun

Locations: Suth=Sutherland, Saskatoon; Rost=Rosthern; Outl=Outlook-irrigated; Elro=Elrose; Swift=Swift Current; Mord=Morden

Table 3. Yield (g/plot) of field pea varieties grown at five locations in 2002 CDC advanced trial-02

ENTRY	Variety	Class	Rost	Scott	Suth	Outl	Elro	MEAN	%
1	CDC Mozart	Y	595	345	472	3049	609	1014	105
2	Alfetta	Y	492	346	520	3302	558	1044	108
3	Eclipse	Y	797	332	654	2462	751	999	103
4	Carrera	Y	456	311	385	2348	580	816	84
5	1089M-2	Y	588	218	331	3087	613	967	100
6	998M-2	Y	394	317	149	2947	713	904	93
7	998M-3	Y	667	451	341	2672	944	1015	105
8	1329M-3	Y	630	354	463	2978	992	1084	**112**
9	1329M-33	Y	675	281	662	2838	1000	1091	**113**
10	1090M-47	Y	859	406	742	4200	878	1417	**146**
11	1090M-48	Y	723	395	561	4156	729	1313	**136**
12	1062D-12	Y	518	302	538	2551	719	926	96
13	1256S-5	Y	594	254	319	2530	825	905	93
14	1083D-8	Y	591	334	442	2933	711	1002	104
15	1287S-6	Y	536	473	582	3088	545	1045	108
16	1287S-8	Y	848	468	485	3721	590	1222	**126**
17	1088M-10	Y	514	296	413	2379	651	851	88
18	1088M-17	Y	456	244	575	2479	657	882	91
19	1088M-21	Y	358	243	244	2673	752	854	88
20	1088M-26	Y	471	279	313	2290	915	854	88
21	1088M-35	Y	749	313	598	3090	674	1085	**112**
22	1089M-11	Y	474	278	350	2850	685	927	96
23	1089M-24	Y	367	370	466	3130	682	1043	108
24	1089M-32	Y	595	216	499	2105	753	834	86
25	1089M-37	Y	612	293	405	2813	645	954	98
26	1089M-42	Y	651	361	374	2280	617	857	88
27	1089M-49	Y	553	321	388	2985	626	974	101
28	1261S-10	Y	583	382	503	2677	588	947	98
29	1257S-5	Y	246	260	167	2329	738	748	77
30	1096M-8	Y	796	297	753	3434	923	1241	**128**
31	1096M-12	Y	576	309	626	2954	736	1040	107
32	1255S-10	Y	543	319	274	2204	630	794	82
33	1249S-4	Y	759	330	471	2739	872	1034	107
34	1249S-6	Y	659	361	404	2675	666	953	98
35	1249S-7	Y	247	191	127	1306	743	523	54
36	1249S-11	Y	536	350	439	2779	881	997	103
	MEAN		581	322	445	2806	728	976	101
	CV		11.8	15.5	20.7	14.5	15.4		
	REPS		2.000	2.000	2.000	2.000	2.000		

NOTES

Class: Y=yellow, G=green, M=maple, D=Dun

Locations: Suth=Sutherland, Saskatoon; Rost=Rosthern; Outl=Outlook-irrigated; Elro=Elrose; Scott=Scott

Table 4. Yield (g/plot) of field pea varieties grown at five locations in 2002 CDC advanced trial-03

ENTRY	Variety	Class	Suth	Rost	Outl	Elro	Mord	MEAN	%
1	CDC Mozart	Y	585	423	2946	531	1073	1112	112
2	Alfetta	Y	460	346	2468	454	792	904	91
3	Eclipse	Y	547	476	2795	648	1219	1137	115
4	Carrera	Y	343	323	2146	461	818	818	82
5	1286S-6	Y	678	548	3056	659	1679	1324	**133**
6	1100M-9	Y	496	268	3049	339	926	1016	102
7	1239S-8	Y	649	423	2537	473	1086	1034	104
8	874M-13	Y	433	356	2474	576	1275	1023	103
9	873M-5	Y	245	265	2293	736	1423	993	100
10	994M-3	Y	630	456	2549	679	1181	1099	111
11	985M-12	Y	692	541	3080	631	1683	1325	**134**
12	985M-14	Y	909	646	3005	558	1550	1334	**134**
13	985M-15	Y	651	513	2529	585	969	1049	106
14	985M-16	Y	643	577	3183	748	1471	1325	**133**
15	985M-18	Y	635	581	3253	731	1331	1306	**132**
16	985M-23	Y	807	752	3796	610	1462	1485	**150**
17	985M-24	Y	590	666	3204	634	1327	1284	**129**
18	985M-25	Y	668	481	3131	497	1267	1209	**122**
19	985M-26	Y	461	433	3180	386	1050	1102	111
20	985M-27	Y	553	620	3310	678	1429	1318	**133**
21	985M-28	Y	730	363	3106	836	1567	1320	**133**
22	985M-30	Y	490	462	2627	553	1039	1034	104
23	985M-33	Y	603	415	3118	479	1357	1195	**120**
24	985M-35	Y	879	652	3204	747	1465	1389	**140**
25	985M-36	Y	654	761	3396	689	1552	1410	**142**
26	985M-37	Y	663	229	2964	691	1482	1206	**121**
27	985M-38	Y	504	481	2612	485	1057	1028	104
28	1011M-5	Y	669	425	2397	463	763	943	95
29	1011M-6	Y	606	367	3072	341	1204	1118	113
30	984M-1	Y	490	240	3017	561	1271	1116	112
31	984M-12	Y	520	476	2696	658	1456	1161	**117**
32	990M-9	Y	547	365	2553	428	1079	995	100
33	990M-11	Y	620	602	2514	508	1065	1062	107
34	990M-12	Y	570	532	2506	632	1314	1111	112
35	990M-13	Y	671	413	2820	566	1054	1105	111
36	990M-27	Y	551	557	2791	655	1273	1165	**117**
	MEAN		596	473	2872	581	1250	1154	116
	CV		23.8	18.9	7.3	16.7	8.8		
	REPS		2	2	2	2	2		

NOTES

Class: Y=yellow, G=green, M=maple, D=Dun

Locations: Suth=Sutherland, Saskatoon; Rost=Rosthern; Outl=Outlook-irrigated; Elro=Elrose; Scott=Scott

Mord=Morden

Table 5. Yield (g/plot) of chickpea varieties at five locations in the 2002 kabuli regional trial

Entry	Variety	SPG-V	SPG	Elro	Swift	Carm	%
1	Sanford	521	981	634	208	2563	100
2	Evans	859	1047	521	344	1789	99
3	Amit	1357	2674	468	2754	1824	**192**
4	CDC Yuma	704	1439	530	1469	1227	114
5	CDC Chico	1433	2057	456	2068	2688	179
6	CDC Xena	1164	1699	715	569	2762	149
7	CDC Diva	962	1586	670	501	2620	135
8	CDC ChiChi	819	1505	358	1099	893	104
9	95NN-1	1554	3099	805	3195	1535	**222**
10	95NN-29	1340	2916	674	3091	1981	**212**
11	95NN-11	1390	2257	749	3158	1800	**195**
12	95177-47	1450	2116	533	3089	2531	**196**
	MEAN	1129	1088	331	802	2018	
	CV	36	21	25	12	16	
	REPS	6	3	3	3	3	

NOTES

Locations: SPG-V, SPG=Saskatchewan Pulse Growers land near Saskatoon-agronomy site and regular site; Elro=Elrose; Swift=Swift Current; Carm=Carmangay

Table 6. Yield (g/plot) of chickpea varieties at five locations in the 2002 desi regional trial

Entry	Variety	SPG-V	SPG	Elro	Outl	Swift	Carm	%
1	Myles	1093	1688	776	988	3008	2354	100
2	CDC Desiray	1282	2575	719	1211	3093	2175	114
3	CDC Anna	1433	2863	751	908	3418	2699	122
4	CDC Nika	1109	2243	680	930	2837	1487	97
5	92073-40	1359	2335	593	758	2990	2836	107
6	BS1-43	1600	2981	942	1492	4095	3788	**148**
7	92117-14	943	1248	882	316	2820	1853	77
8	92117-25	1380	2712	801	758	2960	2567	114
9	92056-22	1565	2825	1053	887	3826	3216	**133**
10	DH27-4	1592	2160	654	725	3369	2106	106
11	222B-11	2001	3020	547	1738	3279	3697	**146**
12	294-20	1606	2659	1007	1155	3541	2742	**129**
	MEAN	1414	1374	438	552	3270	2627	
	CV	26.0	14.9	23.6	22.6	10.7	20.6	
	REPS	6	3	3	3	3		

NOTES

Locations: SPG-V, SPG=Saskatchewan Pulse Growers land near Saskatoon-agronomy site and regular site; Elro=Elrose; Swift=Swift Current; Carm=Carmangay

Table 7. Yield (g/plot) of chickpea varieties evaluated at four locations in the 2002 kabuli elite trial

ENTRY	Variety	SPG	Elro	Kyle	Swift	mean	%
1	Sanford	571	585	137	755	512	75
2	CDC Xena	745	232	283	709	492	72
3	Amit	1078	337	251	1057	681	100
4	95NN-29	1489	652	578	1824	1136	**167**
5	95NN-12	1063	588	740	1670	1015	149
6	95NN-19	1392	433	424	1960	1052	**154**
7	95NN-28	1640	603	561	1747	1138	**167**
8	95NN-32	1556	455	469	1854	1083	**159**
9	95NN-33	1175	730	717	1768	1097	**161**
10	97-Indian2-96	967	416	480	1302	791	116
11	97-Indian2-112	1114	307	689	1835	986	145
12	97-Indian2-125	957	427	473	1515	843	124
13	239-10	1299	245	917	1883	1086	**159**
14	172-7	1332	453	846	1667	1074	**158**
15	264-5	1308	438	850	2206	1200	**176**
16	264-2	1198	309	792	2049	1087	**160**
17	242-4	1080	533	554	1771	984	145
18	239-16	1285	477	907	1829	1124	**165**
19	242-1	1143	565	736	1943	1097	**161**
20	265-1	1131	448	679	1556	953	140
	MEAN	1176	461	604	1645	972	143
	CV	10.9	47.7	20.2	25.0		
	REPS	2	2	2	2		

NOTES

Locations: SPG=Saskatchewan Pulse Growers land near Saskatoon; Elro=Elrose; Swift=Swift Current

Table 8. Yield (g/plot) of chickpea varieties evaluated at six locations in the 2002 desi elite trial

Entry	Variety	SPG	Elro	Kyle	Swift	Ass	Queb	%
1	Myles	934	649	704	994	651	880	100
2	CDC Desiray	762	620	685	911	853	845	97
3	CDC Anna	1020	801	619	1210	579	958	108
4	CDC Nika	813	548	807	1055	540	922	97
5	92073-40	839	595	961	1674	527	964	**115**
6	304-51	1043	672	904	1706	1398	1071	**141**
7	296-3-38	1032	691	925	1679	901	1097	**131**
8	304-78	944	976	905	1488	954	1066	**132**
9	304-40	1239	797	969	1703	1061	1191	**145**
10	304-82	1021	910	895	1489	1454	1085	**142**
11	296-3-39	795	731	696	1141	780	965	106
12	304-31	1408	825	1133	2009	1108	1308	**162**
13	221-24	721	608	596	1257	138	840	86
14	304-22	1410	961	1144	1989	1126	1201	**163**
15	304-7	1082	752	854	1699	871	1229	**135**
16	304-46	1397	787	947	1636	988	1148	**143**
	MEAN	1028	745	859	1477	870	1048	125
	CV	19.6	18.7	10.8	13.9	24.7	5.6	
	REPS	2	2	2	2	2	2	

NOTES

Locations: SPG=Saskatchewan Pulse Growers land near Saskatoon; Elro=Elrose; Swift=Swift Current
Kyle=Kyle; Ass=Assiniboia; Queb=Normandin, Quebec

Table 9. Yield (g/plot) of lentil varieties evaluated at seven locations in the 2002 lentil Co-op Test-A

Entry	Variety	Class	Good	Rost	Scott	Swift	Ass	Girv	SPG-V	%
1	Crimson	SR	334	357	220	561	407	255	273	66
2	CDC Milestone	SG	626	453	224	984	549	363	460	100
3	Pardina	SB	346	339	240	521	141	347	310	61
4	CDC Robin	SR	580	337	245	696	716	324	423	91
5	1066-E-4	SG	517	418	245	987	982	506	477	113
6	1038-L-18	MG	601	566	290	939	968	494	474	118
7	CDC Blaze	SR	457	337	240	633	654	328	384	83
8	CDC Vantage	MG	624	336	245	678	770	407	438	96
9	1193-2-21	SR	638	470	268	933	1095	403	501	118
10	1193-6-10	SR	588	407	228	835	862	332	453	101
11	1194-3	SR	656	491	249	850	1260	375	562	121
12	1218d-3	SR	549	444	299	926	971	454	452	112
13	1190s-10	SR	555	531	261	925	1117	338	453	114
14	1218d-13	SR	554	524	314	1054	1142	347	587	124
15	1110-13RY-5	SR	522	318	221	850	1388	281	597	114
16	1218d-18	SR	616	529	304	984	956	378	537	118
17	1245s-7	SR	547	415	227	755	985	361	382	100
18	1254s-16	SR	660	478	274	988	1102	390	579	122
19	1266s-24	SR	680	468	293	1058	712	432	518	114
20	1254s-1	SR	764	498	271	746	1165	486	502	121
21	1145-3-6	SR	710	491	280	1063	918	414	542	121
22	1125-1-5	SR	649	565	253	919	1032	424	564	120
23	1119-2-3	SR	615	385	285	897	518	423	489	99
24	1119-2-7	SR	427	367	231	768	527	414	358	84
25	1076-13	SB	441	386	272	822	1024	380	349	100
26	901-1-28RS	SB	671	458	295	1039	1243	318	529	124
27	1153-11	SG	730	418	253	948	1100	378	496	118
28	1207d-13	MG	680	599	268	964	1215	329	431	123
29	1208d-35	MG	509	503	274	986	1279	338	503	120
30	1211-41	MG	660	536	281	929	985	441	445	117
31	1211m-16	MG	600	489	248	1125	1049	407	457	119
32	1162-27	MG	689	522	222	944	1038	296	435	113
33	1134-4-17	MG	685	380	257	730	711	258	642	100
34	1134-4-27	MG	672	447	269	874	808	278	485	105
35	1159-5-11	MG	643	477	274	1008	1358	377	452	125
36	1170s-15	MG	671	551	234	925	1134	462	500	122
	MEAN		596	453	260	885	941	376	473.36	109
	CV		19	16	12	15	12	17	20	
	REPS		3	3	3	3	3	3	12	

NOTES

Class: SR=small red, SG=small green, MG=medium green

Locations: Cood=Goodale, Saskatoon; Rost=Rosthern; Scott=Scott; Swift=Swift Current; Ass=Assiniboia; Girv=Girvin; SPG-V=Saskatchewan Pulse Growers land-agronomy site

Table 10. Yield (g/plot) of lentil varieties evaluated at nine locations in the 2002 lentil Co-op Test-B

Entry	Variety	Class	Good	Elro	Rost	Scott	Swift	Ass	Girv	SPG	SPG-V	%
1	CDC Glamis	LG	604	76	493	301	826	387	140	924	924	118
2	CDC Grandora	LG	441	60	479	216	742	415	0	894	894	105
3	CDC Milestone	LG	408	82	570	311	832	414	344	498	498	100
4	CDC Sovereign	LG	587	107	588	301	1129	1054	424	806	806	147
5	CDC Sedley	LG	362	116	422	217	877	823	243	815	815	118
6	964a-4	LG	769	70	494	337	952	741	239	1087	1087	146
7	1237s-1	MLG	456	86	564	305	1128	1042	314	899	899	144
8	1173s-8	MLG	540	126	601	260	870	928	479	945	945	144
9	1237s-26	MLG	516	110	580	280	1138	650	279	994	994	140
10	1205m-5	MLG	820	138	593	294	1016	720	238	1006	1006	147
11	1196d-5	MLG	679	111	659	254	1197	694	312	1088	1088	154
12	1230d-7	MLG	503	117	636	287	1005	747	245	931	931	136
13	1211-45	MLG	470	111	580	262	914	868	301	825	825	130
14	1231s-3	MLG	538	94	445	268	920	727	220	1052	1052	134
15	1237s-24	MLG	532	90	564	244	797	564	231	995	995	127
16	1230d-10	MLG	597	107	630	315	924	896	285	1280	1280	159
17	1202-19	MLG	522	61	628	284	975	876	180	951	951	137
18	1204m-93	MLG	449	122	484	275	967	604	187	851	851	121
19	1202-14	MLG	583	120	560	300	743	1100	215	815	815	133
20	1231s-5	MLG	635	97	589	262	934	553	256	907	907	130
21	1227s-28	MLG	647	110	584	263	998	771	230	981	981	141
22	1159-67	MLG	605	54	530	224	963	857	90	1074	1074	138
23	1196d-2	MLG	651	119	515	225	881	571	179	946	946	127
24	1201-5	MLG	587	132	362	188	846	916	210	878	878	126
25	1227s-23	MLG	691	79	688	261	1000	671	268	985	985	142
26	1236-8	MG	498	113	572	293	1041	1161	479	818	818	146
27	1140-2-5	MG	638	76	601	254	1049	962	256	1084	1084	152
	MEAN		568	99	556	270	950	767	253	938	938	135
	CV		27	30	19	12	11	18	53	13	13	
	REPS		3	3	3	3	3	3	3	3	12	

NOTES

Class: LG=large green

Locations: Good=Goodale, Saskatoon; Elro=Elrose; Rost=Rosthern; Scott=Scott; Swift=Swift Current; Ass=Assiniboia; Girv=Girvin; SPG and SPG-V=Saskatchewan Pulse Growers land-regular and agronomy sites

Table 11. Yield (g/plot) of dry bean varieties evaluated at six locations in the 2002 dry bean regional trial

Entry	Variety	Class	Oxbo	Cano	Inves	Outlo	Melf	Redv	%
1	Envoy	N	1154	1253	50	796	212	653	72
2	HR 100	N	1057	921	291	587	377	319	62
3	CDC Whitecap	N	822	1169	404	705	779	679	**80**
4	AC Cruiser	N	1152	1342	455	733	737	595	**88**
5	T9803	N	679	911	536	371	788	444	65
6	T9601	N	1020	1313	171	703	556	738	**79**
7	AC Black Diamond	B	966	1169	299	1324	434	1081	**92**
8	CDC Expresso	B	647	866	278	516	549	346	56
9	315-18	B	1178	1408	276	874	288	655	**82**
10	318-51	B	1119	1144	88	498	185	342	59
11	AC Redbond	SR	1010	1220	537	1272	766	1198	105
12	CDC Pinnacle	P	1125	1433	360	1220	659	992	**101**
13	CDC Pintium	P	908	1177	729	1346	526	1030	100
14	HR 99	P	960	1095	237	1146	381	770	80
15	CDC Minto	P	889	1353	532	1420	1079	1107	**112**
16	AC Polaris	GN	947	1495	254	1483	325	1347	**102**
17	CDC Crocus	GN	696	1005	531	1416	551	599	84
18	CDC Polar Bear	GN	670	1045	424	1236	634	1191	91
	GRAND MEAN		944	1184	358	980	546	782	84
	CV		15	10	33	19	34	36	
	REPS		3	3	3	3	3	3	

NOTES

Class: N=navy, B=black, SR=small red, P=pinto, GN=great northern

Locations: Oxbo=Oxbow, Cano=Canora, Inves=Saskatoon Investigation nursery, Outlo=Outlook-irrigated

Melf=Melfort, Redv=Redvers

Table 12. Yield (g/plot) of dry bean varieties evaluated at five locations in the 2002 narrow row dry bean Co-op Test-A

Entry	Variety	Class	Oxbo	Outlo	Inves	Leth	Mord	Mean	%
1	CDC-Nighthawk	B	828	889	135	269	964	617	100
2	AC Black Diamond	B	975	1582	321	423	1895	1039	168
3	316-11	B	704	818	155	168	1369	643	104
4	316-13	B	799	1053	153	312	1576	779	126
5	Redbond	SR	873	1407	636	527	1781	1045	169
6	L98D347	SR	969	1375	602	429	1751	1025	166
7	737-7	SR	823	1280	595	343	1394	887	144
8	737-84	SR	804	1326	560	380	1348	884	143
9	737-22	SR	846	1379	499	467	1714	981	159
10	1045T-3	SR	972	1497	517	451	1615	1010	164
11	802-22	SR	856	1274	562	380	1776	969	157
12	804-10	SR	714	1300	504	480	1672	934	151
13	804-6	SR	800	1455	509	471	1689	985	160
14	805-9	SR	884	1354	517	524	1482	952	154
15	855-2	SR	844	1237	395	409	1321	841	136
16	855-3	SR	975	1195	453	436	1462	904	147
17	1030S-3	SR	963	1449	484	637	1982	1103	179
18	859-14	SR	894	1452	555	517	1548	993	161
	MEAN		862.39	1295.59	452.85	423.50	1574.24	922	
	CV		8	9	22	15	14		
	REPS		3	3	3	3	3		

NOTES

Class: N=navy, B=black, SR=small red, P=pinto, GN=great northern

Locations: Oxbo=Oxbow, Inves=Saskatoon Investigation nursery, Outlo=Outlook irrigated

Leth=Lethbridge, Mord=Morden

Table 13. Yield (g/plot) of dry bean varieties evaluated at five locations in the 2002 narrow row dry bean Co-op Test-B

Entry	Variety	Class	Oxbo	Outlo	Inves	Leth	Mord	%
1	Viva	PK	876	1128	84	516	1466	85
2	504AA-8	PK	610	1211	50	377	1315	74
3	L98C280	PK	575	1460	590	522	1543	97
4	722-8	PK	522	1190	333	470	1575	85
5	1046-2	PK	750	1406	284	593	1774	100
6	1042S-1	PK	734	1327	353	513	1790	98
7	799-12	PK	768	1343	454	496	1737	100
8	801-27	PK	829	1012	471	495	1228	84
9	CDC-Pintium	PT	772	1259	667	674	1441	100
10	95-83-10	PT	831	1333	432	627	1723	103
11	335-8	PT	958	993	274	372	1767	91
12	SC11745-3	PT	508	1390	767	557	1437	97
13	657-3-2	PT	591	1343	684	614	1296	94
14	699-77	PT	625	1275	688	551	1474	96
15	610-8	PT	733	1256	443	553	1289	89
16	794-1	PT	819	1197	294	231	1504	84
17	828A-4	PT	960	1268	451	522	1629	100
18	892M-3	PT	753	1328	355	261	1795	93
19	841-8	PT	863	1338	489	577	1613	101
20	810-78	PT	545	896	687	558	1247	82
21	841-14	PT	974	1345	264	357	1647	95
22	841-20	PT	961	1217	168	400	1617	91
23	786-9	PT	915	1442	468	273	1475	95
24	841-1	PT	875	1313	579	383	1396	94
25	564-3	PT	465	908	194	413	1249	67
26	CDC-Crocus	GN	594	1424	409	426	1296	86
27	AC Polaris	GN	841	1413	287	327	1872	98
28	L98E212	GN	933	1347	136	420	1556	91
29	L99E244	GN	716	1085	104	393	1644	82
30	L99E247	GN	912	1194	80	283	1487	82
31	L99E255	GN	713	1295	125	332	1604	85
32	SC11745-24	BP	678	904	527	327	1208	76
33	DC11730-21	BP	613	951	561	382	1357	80
34	610-23	BY	907	1343	446	446	1481	96
35	534-2	BY	953	1355	334	273	1368	89
36	Othello	PT	738	1412	332	561	1603	96
	MEAN		761	1247	385	447	1514	90
	CV		23	10	21	22	11	
	REPS		3	3	3	3	3	

NOTES

Class: PK=pink, PT=pinto, GN=great northern, BY-bayo; b

Locations: Oxbo=Oxbow, Inves=Saskatoon Investigation nursery, Outlo=Outlook-irrigated

Leth=Lethbridge, Mord=Morden